United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

TREE/SHRUB ESTABLISHMENT

CODE 612

(ac)

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, and/or through encouragement of natural regeneration.

PURPOSE

This practice is used to establish woody plants for one or more of the following purpose(s):

- Forest products such as timber, pulpwood, and energy biomass (Soil Erosion, Soil Quality Degradation, Water Quality, Air Quality)
- Maintain or improve desirable plant diversity, productivity, and health by establishing woody plants (Degraded Plant Condition)
- Create or improve habitat for desired wildlife species compatible with ecological characteristics of the site (Inadequate Habitat for Fish and Wildlife)
- Control erosion (Soil Erosion)
- Improve water quality. Reduce excess nutrients and other pollutants in runoff and groundwater (Water Quality Degradation)
- Sequester and store carbon (Soil Quality Degradation, Air Quality)
- Restore or maintain native plant communities (Degraded Plant Condition)
- Develop renewable energy systems (Inefficient Energy Use)
- Conserve energy (Inefficient Energy Use)
- Provide for beneficial organisms and pollinators (Inadequate Habitat for Fish and Wildlife)
- Enhancing aesthetics

CONDITIONS WHERE PRACTICE APPLIES

Tree/shrub establishment applies on any appropriately prepared site where woody plants can be grown.

Utilize other practices for specialized tree/shrub establishment situations, e.g., Riparian Forest Buffer-391 or Critical Area Planting-342.

CRITERIA

Use the following criteria in planning and applying this practice. The general criteria applies to all Tree/Shrub Establishment NC Conservation Practice Standard (CPS) 612. Additional criteria apply based on the intended purpose(s) of the practice.

General Criteria Applicable to All Purposes

Selecting Plant Species

Selected species or composition of species that are adapted to soil, site, climatic conditions, and planned purpose(s).

Only viable, high-quality and adapted planting stock or seed shall be used.

No plants on the state or federal noxious weeds list shall be planted.

Spacing and Density

Determine desired stocking levels for trees and/or shrubs based on ecological characteristics of the site and species, and landowner objectives. Planting or seeding rates will be adequate to accomplish the planned purpose(s). Use the table and formula below to convert planted spacing to a stocking rate (trees per acre).

Convert Plant Spacing to Stocking Rate	
[1]Plant Spacing (L X R)	[2]Stocking (trees per Rate acre)
6 X 10	726
7 X 10	622
8 X 10	545
8 X 12	454
10 X 10	436
12 X 12	303
[1] R = row width (ft.) L = in-row distance between plants (ft.)	**Stocking Rate Formula** $^{2}\text{Stocking Rate} = \frac{43560\ ft^2}{R \times L}$

See *Table 1: Conifer*s or *Table 2: Hardwood* for recommended minimum and maximum spacing between plants.

Site Preparation and Planting

A ***precondition*** for the NC CPS Tree/Shrub Establishment 612 is appropriate site preparation, which shall be sufficient for establishment and growth of selected species. Refer to NC CPS Tree/Shrub Site Preparation 490.

Choose appropriate planting dates and handling methods to increase rates of survival. Select planting techniques and timing appropriate for soil and site conditions.

Evaluate the site to determine if mulching, supplemental water or other cultural treatments (e.g., tree protection devices, shade cards, brush mats, etc.) are needed to assure adequate survival and establishment. Minimize the need for supplemental water and/or nutrients by choosing site-adapted plant materials, planting methods, and planting seasons. Where supplemental moisture is needed to achieve tree/shrub establishment use NC CPS 441 – Irrigation System, Microirrigation.

Time to Plant - plant bare root seedlings during the dormant season. The planting season can be extended 2 to 4 weeks by properly handling and keeping dormant seedling in cold storage. Containerized plants may be planted over wider time period. Avoid planting when the ground is frozen, excessively wet and sticky, or excessively dry.

Planting Methods – seedlings may be planted by hand or with a machine transplanter.

Machine – machine transplanters can be used where site conditions (logging debris, steep slopes, wetness, etc.) do not prohibit operation. Machine prepared slits or furrows should be free of plant stems, leaves or other litter.

Hand – hand planting with bars, dibbles and mattocks is effective on most soils. Hand planting equipment must be able to prepare a hole with adequate depth for the stock being planted. Mattocks are usually required on steep or eroded areas. Shovels are generally used to plant large containerized plants. Rocky conditions or heavy soils may require a special heavy duty bar (ex. KBC planting bar).

Other General Criteria

For Natural Regeneration - when utilizing natural regeneration to establish trees and/or shrubs, ensure that a source of seed and/or vegetative propagules is or will be present, or that advanced reproduction exists, sufficient to achieve objectives. Where natural regeneration relies on seed sources, apply any needed stand treatments and/or site preparation at appropriate times to facilitate germination and establishment of seeds from desired species. Modify forest stand conditions as needed, using NC CPS Forest Stand Improvement (Code 666), to create favorable stand structure for initiating natural regeneration. Use NC CPSs Prescribed Burning (Code 338), Brush Management (Code 314), and/or Herbaceous Weed Control (Code 315), as needed, to obtain the desired species composition, density, and arrangement of trees/shrubs in naturally regenerated areas. Implement coppice regeneration (originating from root shoots or stump sprouts) based on suitability of tree species, age, diameter, and site conditions. Determine the correct timing for coppice regeneration based on species characteristics.

Use tree/shrub planting to accomplish or supplement forest stand regeneration in locations where natural regeneration of desired species is not possible, or will not meet objectives.

For Interplanting young stands – interplanting is usually done by hand with dibbles, mattocks or spades. Interplanting should be done within the first year following failure of the original planting. *The objective of interplanting young stands is to attain at least the minimum desired average stocking (spacing) of the species planted.*

Release of interplanted trees may be required, generally in the spring after planting (see NC CPS – Forest Stand Improvement 666).

For Planting Patches or Openings – openings within established stands of trees should only be planted if they are large enough to permit direct sunlight to reach the ground for several hours every day. Minimum opening width or diameter should be *at least twice*the height of surrounding trees.

For Direct Seeding – seed should be ordered from a reliable commercial seed dealer. A local adapted seed source is preferred. Lots should contain no more than: 10% empties (by number), 10% moisture (by weight), and 2% impurities (by weight). For broadcast seeding, the site must be prepared sufficiently to insure direct soil-seed contact. Hand or machine planting should prepare an 8-12 inch spot or width where the seeds are planted. Do not direct seed steep eroded slopes or deep sandy soils unless the seed can be covered with ½ inch of soil – a very time consuming operation. Release of direct seeded plants may be required after seeds have sprouted.

Seed Treatment including stratification and repellant coating are essential for all pines except longleaf. Stratification hastens germination. Coatings include chemicals to repel birds and rodents; and, a lubricant to help seed flow through a seeding machine.

Timing of planting seeds should generally be about the time of the last killing frost. November – February are the preferred seeding times for longleaf pines.

Planting rates for broadcast seeding should be 10,000 to 15,000 seed per acre. For hand planting use the planned spacing for the selected species and drop six seeds on exposed soil in a prepared one foot square area.

Protect tree and shrub plantings, seeded areas, and naturally regenerated areas, from unacceptable adverse impacts of pests, wildlife, livestock, and/or fire. Protect from pests, as necessary, by applying integrated pest management techniques for pest prevention, avoidance, monitoring, and suppression.

Removal of products (e.g., trees, biomass, medicinal herbs, nuts, fruits, etc.) is allowed, provided that conservation purpose(s) are not compromised by the loss of vegetation or by harvesting disturbance.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Note: Specific pesticide recommendations will be obtained from personnel who are licensed by the NC Department of Agriculture and Consumer Services in specialty area Agricultural Pest Plant Category G (forest) or - O (agricultural, plant) in accordance with North Carolina Pesticide Laws and Regulations. All pesticides must be registered for use by North Carolina and approved for use by the U.S. Environmental Protection Agency (EPA). Refer to the current issue of "North Carolina Agricultural Chemicals Manual" for guidelines, rules and regulations regarding use of pesticides. Users must **always** follow instructions and safety precautions on the container label when handling, applying, or storing pesticides.

Additional Criteria for Forest Products such as Timber, Pulpwood, etc.

For Timber/Pulpwood – select a variety and spacing based on projected markets and rotation period that meets landowner objectives/requirements. Input from a professional forester is recommended.

For Energy Biomass – select a variety that grows quickly (short rotation for biomass), has a locally available market, and is easily chipped, chopped or pelletized to burn as fuel. Consult a professional for variety selection and planting recommendations. See Additional Criteria forDeveloping Renewable Energy Systems.

For Christmas Trees – Christmas tree production requires land of suitable quality and adequate area. The table below summarizes some species that can be grown for Christmas trees in North Carolina.

Species	NC Region		
	Coastal	Piedmon	Mountain
Red Cedar	x[1]	x[1]	
Virginia Pine	x	x	x[2]
Eastern White	x	x	x
Leyland Cypress	x	x	
Fraser Fir			x

[1] Local Sales

[2] Not generally used in commercial operations

Red cedar has been a traditional natural Christmas tree in NC – (prickly foliage, poor form and color).

Virginia Pine is being genetically improved for better Christmas tree characteristics – (rapid growth, 4-6 yr. rotations possible).

Eastern White Pine is susceptible to root diseases, so avoid piedmont soils where plastic clay is within 1 foot of the surface – (7-10 years required to grow a 7-8 foot merchantable tree from a 2 yr. old seedling)

Leyland Cypress is a relatively new variety used for Christmas tree production – (potential bag worm problems, fast growing, 5-7 year rotations possible)

Fraser Fir sells for the highest price of any Christmas tree grown in NC – (7-12 years to grow a 7-8 foot tree from a 4- 5 yr. old transplant)

For Nuts and Berries – select an appropriate nut or berry producing variety for site conditions.

Consult a professional horticulturalist for variety selection and planting recommendations.

For Pine Straw (mulch) – where adapted, longleaf pine is the species of choice for pine straw production in North Carolina. Loblolly pine is a secondary choice.

For Mulch (chips) - select a variety that grows quickly, has a locally available market, and is easily chipped or chopped. Consult a professional for variety selection and planting recommendations.

Additional Criteria for Wildlife Habitat

Tree/shrub selection and stocking (spacing) shall benefit targeted wildlife species. Consult a professional biologist for woody plant selection and planting recommendations for specific wildlife species management.

General guidelines for wildlife that require grasses or early successional vegetation - plant trees at lower stocking levels (wider spacing) to allow for more grass, weed, forb and brush habitat.

General guidelines for small game and non- game species – establish hardwood and mixed pine-hardwood trees, especially in riparian areas. This habitat type is known to be important for many neo-tropical migratory birds.

Additional Criteria for Improving or Restoring Natural Diversity

Composition of species selected for planting or favored for natural regeneration will be indigenous or native to the site and create a successional stage or state that can progress to the desired natural community. Consult a professional biologist for variety selection and planting recommendations.

Longleaf pine – longleaf pine habitat is considered an 'endangered ecosystem' in the Southeast United States. Suitable sites that occur within the former longleaf pine community range are candidates for longleaf pine restoration.

Wetland and Bottomland Hardwood - tree/shrub establishment is an important component of wetland and bottomland hardwood restoration. On-site evaluation and site specific recommendations are required to restore these ecosystems. Consult a professional biologist or forester.

Additional Criteria for Restoring or Maintaining Native Plant Communities

Species selected for planting, or those favored in natural regeneration, will be native to the site and will create a successional state that progresses toward the identified target plant community.

Additional Criteria for Habitat for Beneficial Organisms

Plant trees and shrubs that provide habitat and food sources for beneficial organisms, such as pollinators, predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and terrestrial rodent predators. Select plant species that meet dietary, nesting, and cover requirements for the intended beneficial organisms during the critical period for control of target pests and, if possible, for the entire year.

Protect beneficial organisms from harmful pesticides.

Additional Criteria for Long Term Erosion Control and Improvement of Water Quality

Long term erosion control and/or improved water quality is a general consequence for most tree/shrub planting. Where erosion control and improved water quality is a primary purpose be sure to select a tree/shrub species (or mixture) that has a high growth rate and is adapted to the soil/site conditions.

Additional Criteria for Reducing Nutrients and Pollutants

When plantings are used to remove excess nutrients from runoff or groundwater, select species that have fast-growth characteristics, extensive root systems, and a high-nutrient uptake capacity. Trees and shrubs

used to reduce pollutants must be tolerant of the types of pollutants contained in effluent or soils at the site.

Additional Criteria for Treating Waste

Treatment of wastes with trees/shrubs is very site specific and requires high levels of management. Species used to treat waste should exhibit fast growth characteristics, have extensive root systems capable of high nutrient uptake, and produce wood/fiber products in short rotations. Treating waste with trees is often done as part of a constructed wetland (NC CPS 656).

A professional consultant is recommended to advise and evaluate the whole waste treatment system. State and local government regulatory agency approval may be required.

Additional Criteria for Storing Carbon Storage in Biomass

For optimal carbon sequestration, select plants (or mixtures of plants) that have a high growth rate and are adapted to the site. Plant the appropriate FULL stocking rate and manage for fast growth. Some plants may fix carbon in biomass and soils more efficiently than others. Consult a professional for current research on adapted plants that sequester carbon more efficiently.

Carbon sequestration benefits increase when trees are managed for durable, lumber products over a longer rotation. Calculate predicted carbon sequestration rates using current, approved carbon sequestration modeling technology.

Additional Criteria to Reduce Energy Use

To conserve energy, plant and orient trees strategically to provide shade to a building or structure and reduce solar heat gain during the summer. The first priority is placement on the building's west side where the greatest daily heat gain occurs. Second priority is the building's east side. Deciduous trees are usually used for this purpose.

Select plants with a potential height that will be taller than the structure/facility protected.

Use plant densities that optimize shade and meet energy reduction needs.

Trees planted within 30-50 feet of a building generally provide effective shade to windows and walls depending on tree height.

Keep trees at least 10 feet or further from structures depending on mature crown spread, to avoid damage to foundations and restricted maintenance access to walls and windows.

Additional Criteria for Developing Renewable Energy Systems

Select plants that can provide adequate types and amounts of plant biomass to supply identified bioenergy needs.

Manage the intensity and frequency of energy biomass removals to prevent long-term negative impacts to the site.

Harvest biomass for energy in a manner that will not compromise other intended purpose(s) and functions of the site.

Additional Criteria to Conserve Energy

Increase energy efficiency by planting trees to provide shade for buildings.

Select plants with a potential height growth that will be taller than the structure or facility being protected.

Use proper plant densities to optimize the shade produced.

Design tree and shrub plantings to avoid damage to structures, and to allow adequate space for maintenance access to walls and windows. Plant at a distance that is greater than mature crown spread, and select species that develop deep root systems.

To protect structures from heat loss due to wind, use NC CPS Windbreak Establishment (Code 380).

Additional Criteria for Sequestering and Storing Carbon

For shorter term, rapid carbon sequestration, select species that have high-growth rates, recognizing that they are typically short-lived. For longer term storage of carbon, select plants with a long life span, the ability to reach a large size, high-wood density, and potential for use in long-lived products. Establish and maintain a fully stocked stand.

Additional Criteria for Enhnacing Aesthetics

Select species with features such as showy flowers, brilliant fall foliage, persistent colorful fruits or noteworthy growth forms and shapes (see table below for a partial listing of North Carolina trees). Use these species along edges, along access roads, and/or walkways to create an elegant and appropriate appearance. Aesthetic considerations for tree/shrub planting are often secondary to other criteria.

NC Species with Aesthetic Features (partial list)

Species	**Flowering**	**Foliage**
Black gum		X
Dogwood	X	
Holly		X
Live Oak		X
Magnolia	X	X
Red Maple		X
Redbud	X	
Red cedar		X
Sassafras		X
Sourwood	X	X
Sweet gum		X
Wild Plum	X	
Yellow Poplar		X

Table 1: CONIFERS – Recommended Species and Spacing

Species & Spacing*	**Coastal Plain**	**Sandhills**	**Lower Piedmont**	**Upper Piedmont**	**Mountains**

Atlantic White Cedar[11] minimum/Ac. 12'x12' maximum/Ac. 8'x10'	**X**				
Loblolly Pine[1] minimum/Ac. 12'x12' maximum/Ac. 7'x10'	**X**	**X**	**X**	**X**	**X**[2]
Longleaf Pine[3,10] minimum/Ac. 12'x12' maximum/Ac. 6'x10'	**X**	**X**	**X**		
Shortleaf Pine[4] minimum/Ac. 12'x12' maximum/Ac. 6'x10'			**X**	**X**	**X**[5]
Virginia Pine (improved)[6,9] minimum/Ac. 10'x 10' maximum/Ac. 6'x10'				**X**	**X**[7]
Eastern Redcedar 5'x10'	**X**	**X**	**X**	**X**	
Eastern White Pine minimum/Ac. 12'x12' maximum/Ac. 7'x10'				**X**	**X**
Fraser Fir9 5'x5'					**X**[8]

** Other conifer species may be used if reviewed and approved by NRCS-NC-ECS staff or professional biologist/forester.* ** Minimum/maximum spacing in this table are recommendations for commercial timber production; spacing can be varied to meet landowner objectives, level of management and potential for commercial thinning. Spacing for environmental, restoration, aesthetics or wildlife can generally be wider (fewer plants per acre) than the indicated minimum.*

[1] Not recommended on sands over 30” in depth. [2] Cherokee, Clay, and Macon only up to 1,500 elevation. [3] Best species for sands over 30” in depth and within former longleaf pine community range. [4] Do not plant on severely eroded soil. Adapted to dry, infertile soils. [5] Recommended up to 2,500 ft. elevation.	[6] Adapted to severely eroded soil. For erosion control. [7] Recommended to 2,500 ft. elevation. [8] Above 2,000 ft. elevation. [9] For Christmas tree production. [10] Containerized stock advocated over bare-root. [11] Generally planted for environmental purposes and timber production secondarily **X** = recommended

Planting Conifer Seedlings

Seedling Quality – Seedlings should exhibit the following characteristics: disease-free; root collar diameter no less than one- eighth inch; stiff and woody, with secondary needles present; maximum top length 14 inches; and, root system not less than five inches nor more than 9 inches long.

Care of Seedlings - Successful plantations depend on the care of planting stock. Every effort should be made to keep seedlings in good condition. Planting stock can generally be better kept in better in bales/bags/boxes - as it comes from the nursery - than in field heel-in beds. This is particularly true where the stock will be planted within two to three weeks. Seedling roots must be kept moist at all times. Seedlings (especially the roots) should not be exposed to the sun, wind, heating, drying, or freezing at any time from lifting at the nursery plantbeds until planted. Roots should not be exposed to sun or wind for more than 10 minutes. If cold storage is not available, keep seedlings packed in bales after delivery. They should not be stored in bales longer than 2 weeks.

The following additional precautions should be taken in storing bales/bags/boxes:

- Keep in a cool place. Avoid heated rooms.
- Protect bales/bags from freezing.
- Water at least once each week to keep roots and packing moss moist.
- Stack bales/bags on sloping racks to insure air circulation, easy watering, and drainage of excess water.

Stock must be kept cool (34 - 38 degrees F) and protected from “heating”. Stock which is well watered, protected from direct sunlight, and properly aerated usually will not heat. Seedlings subjected to heating should be discarded and not planted. The sooner seedlings are planted after being lifted from nursery beds, the better the chances for survival and normal growth.

Loose seedlings should be “heeled in” immediately upon arrival. Steps to follow are

- Select a well-drained and slightly sloping spot with some shade.
- Dig the trench 2 to 4 inches deeper than the seedlings’ roots are long. One side of the trench should be smooth and slightly sloping.

Planting – during planting, take the following precautions:

- Water, wet moss, or wet burlap should be kept around the seedling roots in the field…do not allow roots to dry or be exposed to sunlight.
- When hand planting, one seedling should be selected at a time and immediately planted.
- Roots must be planted straight down, not twisted, balled or J-shaped. The opening must be deep enough to accommodate the root system in its normal position.
- Soil must be packed firmly around planted seedlings with no air pockets around roots. Test by grasping the seedling by 4-5 needle tips and pulling…if the seedling comes out of the ground, the seedling is not packed firm enough; if the needles come loose, the seedling is packed firmly.
- For Machine Planting – Check for depth of trench, tracking of packing wheels, and closure of trench. Check root placement by opening one side of the trench with a shovel to expose the seedling in place.
- At the end of each day, “heel in” the loose seedlings or repack them in wet moss and wrap tightly with waterproof paper

Table 2: Hardwoods – Major Species by Region and Soil Characteristics

Species[1]	Plant Spacing[2]	Coastal Plain Soil Characteristics				
		Well drained Deep, Rich (River Terrace)	Heavy, Somewhat Wet Soils (Mineral Soils)	Very Poorly Drained Permanently Wet Soils w/ Clay Base-Muck or Peat	Deep Sands	Shallow, Sandy Loamy Soils Over Clay Base (> 6" Topsoil)
Cottonwood	12' x 12'	**X**				
Cottonwood cuttings are easily and quickly planted using a pointed steel rod, approximately 3/4" in diameter and 36"-42" long. The rod is used to create a hole in the soil at least 12" deep. A cottonwood cutting 20" or longer is placed in the hole, leaving 4-5" of cutting above ground. Soil is then firmed around the cutting. Cottonwood cuttings of lengths up to 40" may be planted.						
Green Ash	12' x 12'	**X**	**X**			**X**
Red Maple	12' x 12'		**X**	**X**		
Red Oaks (Cherrybark)	12' x 12'	**X**	**X**			
Swamp Chestnut Oak	12' x 12'	**X**	**X**			
Sweetgum	12' x 12'	**X**	**X**			**X**
Sycamore	12' x 12'	**X**				**X**
Tupelo Gum	12' x 12'		**X**	**X**		
Water-Willow Oak	12' x 12'	**X**	**X**			**X**
Yellow Poplar	12' x 12'	**X**	**X**			

Table 2: Hardwoods – Major Species by Region and Soil Characteristics (continued)

Species[1]	Plant Spacing[2]	Piedmont Soil Characteristics			
		Loamy, Clayey, Red, Droughty (Eroded)	Upland Slopes & Ridges; Deep, Loamy Soil (Little Erosion)	Small Stream Bottom (Variable)	Major River Bottoms (River Terraces)
Green Ash	12' x 12'			**X**	**X**
Red Oaks	12' x 12'		**X**		**X**
Sweetgum	12' x 12'		**X**	**X**	**X**
Sycamore	12' x 12'		**X**	**X**	**X**
Water-Willow Oak	12' x 12'			**X**	**X**
White Ash	12' x 12'			**X**	**X**
Yellow Poplar	12' x 12'		**X**	**X**	

Table 2: Hardwoods – Major Species by Region and Soil Characteristics (continued)

Species[1]	Plant Spacing[2]	High Piedmont & Lower Mountains Soil Characteristics			
		Upland Ridges Rocky, Eroded (Less than 3" Topsoil)	Upland Ridges, Deep Soil (less than 50 % Rocks)	Coves, Valleys	High Plateau
Black Walnut	20 'x 20'			**X**	
Cherry	12' x 12'		**X**	**X**	

Species[1]	Plant Spacing[2]	High Piedmont & Lower Mountains Soil Characteristics			
		Upland Ridges Rocky, Eroded (Less than 3" Topsoil)	Upland Ridges, Deep Soil (less than 50 % Rocks)	Coves, Valleys	High Plateau
Northern Red Oak	12' x 12'		**X**	**X**	
White Ash	12' x 12'			**X**	
Yellow Poplar	12' x 12'		**X**	**X**	

[1] Selected hardwood species must be adapted to the site and seedlings must be of correct geographic source. Other species may be used if reviewed and approved by NRCS-NC-ECS staff or professional biologist or forester.

[2]On productive sites with good expected survival 12'x12' spacing can be increased to 12'x15' or ever 15'x15' for commercial timber production. Spacing for environmental, restoration, aesthetics or wildlife will generally be wider (fewer plants per acre) than 12'x12'. Where tree tubes and/or weed mats are used at planting, plant spacing may be reduced to 100-200 trees per acre.

Planting Hardwood Seedlings

As a general guide, a site should have a pine site index of 90 feet or more at 50 years if hardwood plantations are to be considered as a satisfactory crop. Don't plant sites that have been damaged (erosion, compaction, rutting) by site preparation or logging.

Newly planted seedlings need to grow without severe competition. This requires intensive site preparation and proper aftercare to control competing vegetation. Plantings must be carefully protected - hardwoods are killed or injured by light fires; they can be destroyed by grazing cattle and deer; and, they are sensitive to herbicides

Seedling Quality – Seedlings must be large (at least 3/8" root collar diameter) and healthy. Cull and discard small or weak seedlings.

Care of Seedlings - Care of hardwood seedlings is similar to care of conifer seedlings.

Planting – Planting hardwood seedlings is similar to planting conifer seedlings. Some hardwood seedlings are larger, requiring a deeper hole or trench and more care to keep roots straight down.

CONSIDERATIONS

General Considerations

Use locally adapted seed, seedlings or cuttings. All plant materials should comply with a minimum standard, such as the American Nursery and Landscape Association, Forest Service, or state- approved nursery. Consider utilizing plant materials that have been selected and tested in the Plant Materials Program or in similar tree/shrub improvement programs.

Plant community restoration requires extensive planning and management to approximate native conditions. Have realistic expectations, and be prepared to apply management/ improvement activities over an extended period of time.

Consider using diverse tree and shrub species combinations which best meet the needs of desired wildlife and pollinator species.

When selecting plant materials, consider whether the species, variety, or cultivar possesses aggressive traits, and whether it poses a potential threat to the existing or desired plant community.

Consider the potential impacts of extreme weather events (e.g., drought, flooding, wind, late spring frosts) when selecting plant species and sites for planting.

Some cost share programs will only reimburse costs for planting up to a set stocking level or density.

While pines generally are self-pruning, widely spaced (<300 trees/acre) stands may not self-prune and may require pruning to grow clear wood and improve timber value. Refer to NC CPS Tree Shrub Pruning 660.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Internal emotional feelings involved with passing something of intrinsic value—a legacy—to the next generation can be an important motivator for tree planting.

Consider using diverse species combinations which best meet local wildlife and pollinator needs.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Natural regeneration from seed generally increases genetic diversity while sprouting (asexual reproduction) perpetuates existing genotypes.

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Residual chemical carryover should be evaluated prior to planting

Consider weed barrier/moisture conservation fabric (at least 4 feet wide) and/or tree tubes where needed to improve establishment success of plant materials and help reduce rodent damage. Where tree tubes and/or weed mats are used, plant stocking rates can be reduced to 150-200 plants per acre depending on landowner objectives and planned level of management.

Soil tests may be needed on sites with expected phosphorus deficiency (such as poorly drained savannas-flatwoods-organics of the NC Coastal Plain). Fertilize as part of site preparation to improve phosphorus levels where soil tests indicate. Soil testing should be considered where significant capital outlays for the customer are involved.

Consider invasive potential when selecting plant species.

Considerations for Insects and Disease

1. Pales weevil is the most serious insect pest for pine seedlings on recently cutover pine lands. In susceptible areas, purchase treated seedlings if available. Another preventive measure is to delay planting for one season following harvest cutting. Pales weevil population is directly proportional to volume of slash and stumps (more slash and stumps = more pales weevil).
2. Fusiform rust is the most important disease of loblolly pines. In locations where the incidence of fusiform rust is high, consider planting rust resistant stock or species less susceptible to rust (longleaf, shortleaf, and white pine.)
3. Brown spot on planted longleaf pine may be controlled or prevented by prescribed burning. Application of this practice will ensure better survival and increase early height growth at a reasonable cost. Refer to PRESCRIBED BURNING – Practice Standard 338.

Considerations for Organic Systems During Vegetation Establishment

Natural mulches, such as wood products or hay, can be used to support tree/shrub establishment by controlling competing vegetation, as a viable alternative to using herbicides. Certified weed-free mulches are preferred. NC CPS Mulching 484.

Pests may be managed through augmentation or introduction of predators or parasites and development of habitat for natural enemies of pests; non-synthetic controls such as lures, traps, and repellents may be used.

Invasive plant species may be controlled through mulching with fully biodegradable materials; mowing; livestock grazing with protection for plantings; hand weeding and mechanical cultivation; pre-irrigation; flame, heat, or electrical means. Use NC CPS Prescribed Burning 338, as needed.

Considerations for Reducing Energy Use

When trees are planted to reduce summer energy use in buildings, consider prioritizing their placement on the west side of the building, where the greatest daily solar heat gain occurs. The second priority is the east side. Trees or shrubs planted within 30 to 50 feet of a building generally provide effective shade to windows and walls, depending on tree height potential.

Deciduous tree or shrub species planted adjacent to the south side of buildings in cool climates can provide shade in the summer yet allow sun to reach the building in winter.

This practice has the potential to affect National Register listed, or eligible, significant cultural resources (CULTURAL RESOURCES INFORMATION - NC, FOTG Section II). Follow NRCS state policy for considering cultural resources during planning.

PLANS AND SPECIFICATIONS

Specifications for applying this practice and protection of the site shall be prepared and recorded using approved specification sheets, job sheets, technical notes, narrative statements in the conservation plan (including references to plans prepared by other agencies or consultants), or other acceptable documentation.

Plans and specifications for complex situations involving multiple planting methods and species for varied site conditions should be well documented. Separate specifications can be prepared for each planting method, species, site, etc.

Minimum documentation will include:

- map showing fields or areas where tree/planting will be done; additionally in forest land the map should delineate:
  - streams and water bodies
  - required filter strips/SMZ's
  - additional sensitive areas such as critical areas or cultural resources that need to be considered during site preparation activities
- plant material or species to be planted
- plant spacing and arrangement
- site preparation and planting method(s); and, equipment to be used
- site specific needs for soil amendments, cultural, pest management or other practices
- tree planting or forest management plan prepared by a registered forester when available
- statement requiring compliance with all federal, state and local laws
- required operation and maintenance instructions

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

- Planting Follow-Up - Seedling stocking can be determined a year after planting by taking 1/100 (radius of 11.75 ft.) acre randomly sampled plots. Sufficient plots are needed to get a good representation of the planted area. In general, 300 or more established seedlings is considered adequate. Hardwoods are harder to evaluate in the 1st year after planting. Additional time may be needed to fully evaluate hardwood survival.
- Replanting will be required when survival is inadequate. Generally, replacement or interplanting should be done within 2 years after the original planting.
- If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled. Planted seedlings or cuttings should be released from any overtopping vegetation not later than 2 years after planting. Refer to Forest Stand Improvement – NC CPS 666. Use extreme care if foliar spray herbicides are used on hardwood plantings.
- Burn or mow the area periodically, if needed to maintain the health of the plant community. Do not conduct maintenance practices and activities during the primary reproductive period of wildlife. Exceptions can be considered to maintain the health of the vegetative community if such exceptions do not conflict with agency requirements.
- Inspect trees and shrubs periodically and protect from adverse impacts including insects, diseases, competing vegetation, fire (see Firebreak – NC CPS 394) and damage from livestock or wildlife. Pine plantings should be protected from grazing until trees are at least 8-10 feet tall. Domestic livestock should be excluded from all hardwood and Christmas tree plantings.
- Access by vehicles or equipment during or after tree/shrub establishment shall be controlled to protect young plants and minimize erosion, compaction and rutting. Refer to Access Control – NC CPS 472, if vehicular or equipment traffic is a potential problem.
- Supplemental water will be provided as needed where possible and feasible.
- Periodic applications of nutrients may be needed to maintain plant vigor.
- After trees or shrubs are established, refer to Forest Stand Improvement – NC CPS 666, and Tree/Shrub Pruning – NC CPS 660 for subsequent management.

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